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Chapter 11

Ginger and Turmeric

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Biodiversity of ginger and turmeric is concentrated in South Asia, South East Asia, Pacific Islands, Central and South Americas, and African regions. Cultivated diversity is maximum in South and South East Asian countries.

India is known as 'Land of Spices'. Since time immemorial a variety of spices are grown in this country. India is a world leader in production and export of ginger and turmeric. In fact, 'Alleppey turmeric', 'Rajapuri turmeric', 'Cochin ginger' 'Wyanadan ginger' etc. are synonymous with superior quality in these spices.

Ginger: Origin, Producing Countries and Systematics

Ginger (*Z. officinale* Rosc.) originated in South East Asia and is under cultivation since ancient times in India and China. Incidentally, centre of diversity of ginger is also in this region. Though a putative wild type of *Zingiber officinale* is collected from Western Ghats of India, its occurrence in wild habitat is yet to be confirmed. (Sasikumar *et al.*, 1995).

At present ginger is cultivated in India, China, Jamaica, Taiwan, Sierra Leone, Nigeria, Fiji, Mauritius, Indonesia, Brazil, Costa Rica, Ghana, Japan, Malaysia, Bangladesh, Philippines, Sri Lanka, Soloman Islands, Thailand, Trinidad and Tobago, Uganda, Hawaii, Guatemala and Australia.

Ginger (*Zingiber officinale* Rosc.) belongs to family Zingiberaceae and natural order Scitamineae.

Baker (1894) recognized 4 sections in Zingiberaceae and *Zingiber officinale* is included in Section II *Lampuzium* Haron. Holttum (1950) included *Zingiber* in tribe *Hedycheae* along with other genera like *Curcuma*, *Hedychium* and *Kaempferia*. Burt and Smith (1983), disagreed with Holttum and proposed *Zingiber* as a separate tribe.

Species Diversity

Though *Z. officinale* Rosc. is the most important member of genus, economically there are other species of medicinal and ornamental value (Table 11.1) (Sabu and Dave Skinner, 2005).

Table 11.1: Economically Important Species Diversity in *Zingiber*

Species	Uses	Remark
<i>Zingiber officinale</i> Rosc.	Spice and condiment, medicinal use	Cultivated in India, Africa, Carribans and South East Asian countries
<i>Zingiber mioga</i> Rosc.	Vegetable. Shoot and flowers are edible	Japanese or 'myoga ginger'
<i>Z. montanum</i> (Keonig) Link ex Diet (Syn. <i>Z. cassumunar</i> Roxb.)	Used in traditional medicine	Found in India, Sri Lanka and South East Asian countries
<i>Z. zerumbet</i> (L.) Smith	Medicinal/ornamental use	'Shampoo ginger', common in tropical Asia and USA
<i>Z. amaricanus</i> Bl.	Medicinal use	Grown widely in USA occurs in the teak forests of South East Assia.
<i>Z. aromaticum</i> Val.	Ornamental/medicinal/flavouring	'Puyang ginger' of Indonesia, native of tropical Asia.
<i>Z. argenteum</i> J. Mood and I. Theilade	Ornamental	Endemic to Malaysia
<i>Z. bradleyanum</i> Craib	Ornamental	Cultivated in USA
<i>Z. chrysanthum</i> Rosc.	Ornamental	-
<i>Z. citriodorum</i> J. Mood and I. Theilade	Ornamental	Common in Thailand and USA
<i>Z. clarkii</i> King ex Benth	Ornamental	Native of Sikkim, India, lateral spikes.
<i>Z. collinsii</i> J. Mood and I Theilade	Ornamental	Common in USA and Europe
<i>Z. corallinum</i> Hance	Chinese medicine/ornamental	-
<i>Z. eborium</i> J. Mood and I. Theilade	Ornamental	'White ginger' or 'ivory ginger' of Indonesia, now common in the West
<i>Z. griffithii</i> Baker	Ornamental	Malaysian species
<i>Z. gramineum</i> Noronha	Ornamental	'Palm ginger' cultivated in USA
<i>Z. junceum</i> Gagnepain	Ornamental	'Yellow Delight' common in USA
<i>Z. lambi</i> J. Mood and I Theilade	Ornamental	Malaysian species
<i>Z. longipedunculatum</i> Ridley	Ornamental	Cultivated in Australia
<i>Z. malaysianum</i> C. K. Lin	Ornamental	'Midnight beauty', common in USA
<i>Z. neglectum</i> Valet	Ornamental	Common in USA
<i>Z. niveum</i> J. Mood and I. Theilade	Ornamental	Common in USA
<i>Z. ottensii</i> Valet	Medicinal/ornamental	Common in South East Asia
<i>Z. pachysiphon</i> B. L. Burt and R. M. Sem	Ornamental	Cultivated in Australia
<i>Z. rubens</i> Roxb.	Medicinal/ornamental	Indo-Malaysian species introduced to USA
<i>Z. spectabile</i> Griff.	Ornamental/medicinal	Malaysian species common in USA
<i>Z. vinosum</i> J. Mood & I. Theilade	Ornamental	Malaysian species introduced to USA

Baker (1894) described a total of 24 species from Indo-Malayan region. Gamble (1925) recorded seven species from South India such as *Z. officinale* Rosc., *Zingiber roseum* Rosc., *Z. nimmonii* Dalz., *Z. wightianum* Thwaites, *Z. zerumbet* (Lin.) Smith and *Z. neesatum* (Grah.) Ramamoorthy Syn. *Z. pupurem* Rosc. Kumar (1999) reported *Zingiber clarkei* is endemic to Sikkim Himalayas. Other economically important (medicinal) *Zingiber* species found in Sikkim are *Z. capitatum* var. *elatum* and *Z. chrysanthum* etc. (Kumar, 1999).

Cultivar Diversity

Good variability in cultivated ginger is in India and China. In both these countries, most of land races are known after their place of domestication and hence all of them may not be distinct genetically (Tables 11.2 and 11.3). Kerala, Orissa, Meghalaya, Arunachal Pradesh, Karnataka, West Bengal and Andhra Pradesh are the leading Indian states in ginger production totaling to 70000 ha. in area. In China, ginger is grown in about 13450 ha. In India good variability for yield and quality of ginger is encountered in Kerala and North East India (Table 11.4). Though no sexual reproduction is reported in ginger, geographical spread accompanied by genetic differentiation into locally adapted population augmented by mutation could be the main factor responsible for diversity in this clonally propagated crop. Early movement of settlers across length and breadth of Kerala and story of shifting cultivation in North Eastern India are well documented sociological events. (Sasikumar *et al.* 1999).

Table 11.2: Cultivar/Varietal Diversity in Ginger in India

Sl.No.	Cultivar/Variety	Sl.No.	Cultivar/Variety
1.	Anamika	26.	Rajagarh Local
2.	Assam	27.	Rejatha*
3.	Arippa	28.	Rio-de-Janeiro*
4.	Bajpai	29.	Sargi guda ✓
5.	Burdwan	30.	Saw Thing laidum ✓
6.	China*	31.	Singhihara
7.	Ernad-chernad	32.	Seirra Leone*
8.	Ernad Manjeri	33.	Suprabha*
9.	Ellakallan ✓	34.	Suruchi*
10.	Edappalayam	35.	Suravi*
11.	Himachal ✓	36.	Saying makhim (Pink ginger) ✓
11.	Hingiri*	37.	Taiwan*
13.	Jorhat	38.	Taffingiva*
14.	Juggigan*	39.	Thang-chang
15.	Jamaica*	40.	Thingpui ✓
16.	Karakkal	41.	Thing laidum ✓
17.	Kuruppampady	42.	Thodupuzha
18.	Kunduli Local ✓	43.	Tura
19.	Maran ✓	44.	Uttarpradesh
20.	Mahim ✓	45.	Valluvanad
21.	Mahima*	46.	Varada*
22.	Mananthody ✓	47.	Vengara
23.	Nadia ✓	48.	Wyand Local ✓
24.	Narasapattam ✓	49.	Wynad Kunnmangalam
25.	Poona	50.	Zahirabad

+: Exotic; *: Improved variety

Table 11.3: Cultivar Diversity of Ginger in China

Category	Variety/Cultivar
Sparse seedling/big fleshy rhizome	Gandzhou, Shandong Laiwu
Dense seedling/fleshy type	Guangzhou, Zhejiang
Edible/Medicinal	Fujian red bud, Hunan yellow heart, chicken claw ginger, Xingguo ginger
Edible/processed	Guangzhou (fleshy type), Fuzhou ginger (Purple ginger), Tongling (White ginger), Fujian bamboo ginger, Zunyi (big white ginger), Leifeng ginger.
Ornamental ginger	Laishe ginger Flower ginger Tea ginger Strong ginger Hengchun ginger Hekou ginger
Other types	Zaoyang (Hubei province) Zunji Big (Guizhou) Chenggu Yellow (Shaxi) Yulin round Fleshy (Guangxi) Bamboo root ginger (Sichuan) Mianyang (Sichuan) Xuanchang (Ahui) Yuxi yellow (Yunnan) Laiwu Slice ginger (Shandong) Yellow claw (Zhejiang) Taiwan fleshy (Taiwan)

Source: Ravindran *et al.*, 2005.

In West Africa two main types of ginger are grown (Tindall, 1968). Graham (1936) reported that 5 kinds of ginger are recognized in Jamaica viz. St. Mary, Red Eye, Blue Turmeric, Bull Band China Blue. Ridley (1912) reported 3 forms of ginger from Malaysia viz. 'halyia betle' (true ginger) 'halyia udang' (red ginger) and 'halyia bara' (yellow ginger). A red variety of ginger, *Z. officinale* var. *rubra* (pink ginger) and a 'withered skin variety' are also reported from Malaysia. Rosales (1938) reported two cultivars from Philippines viz. 'Native' and Hawaiiin'. 'Taffingiwa' is the common ginger in Nigeria, next important being 'Yasun Bari' (black ginger). (Ravindran *et al.*, 2005). Ginger is cultivated in about 14500 ha. in Nigeria.

In Japan, ginger cultivars are grouped into three types based on their stature (1) dwarf statured, early maturing, profuse tillering types with small rhizomes e.g. 'Kintoki'; (2) medium statured plants with moderate tillers and medium size rhizome e.g. 'Sanshu' and (3) tall plants with big rhizome and less tillers e.g. 'Oshoga' (Ravindran *et al.*, 2005). Sanshu (4x Sanshu) and Buderim Gold are tetraploid ginger varieties grown in Japan (Adaniya and Shirai 2001) and Queensland, respectively. Ginger is grown in about 9900 ha. in Indonesia.

Table 11.4: Ginger Cultivars Identified for Various Uses

✓ End use	Cultivar
High yield (fresh)	Rio-de-Janeiro, Suprabha, Varada, Mahima, Rejatha, Juggigan, Himachal, Hingiri, Maran, Wynad Local, Karakkal, Thingpui, Nadia, Suruchi.
Bold rhizome	Mahima, Rejatha, Varada, Gorubathani, Bhaise, Suravi
High dry recovery	Varada, Mahima, Zahirabad, Jorhat Local, Kuruppampadi, Ernad, Chernad, Mowshom, Rejaha, Maran.
Low fibre	Varada, China, Nadia, Poona, Zahirabad, Mahima.
High oleoresin	Wynad Kunnamangalam, Ernad Chernad, Nadan (Pulpally), Nadan, Himachal, China, Rio-de-Janerio, Maran.
High gingerol & shogaol	Wyand, Baharica, Rio-de-Janeiro, Kunduli, Kunnamangalam, Ambalavayalan, Ernad Chernad, Swathing Pui, Maran, Jorhat Local.
High essential oil	Pulpally, Sabarimala, Valluvanad, Rio-de-Janerio, Nadan (Pulpally), Thodupuzha, Hingiri, Ellakallan, Mananthody
High zingiberene	Baharica, Amaravathy (6) gingerol
Salted ginger	Rejatha and Varada
Ginger candy	Varada

Nepal is another country rich in cultivar diversity of ginger. Ginger is grown in about 6082 ha. in Nepal under different agro-ecological situations. Most of Nepalese ginger cultivars are bold types, known after their locality of cultivation like 'Tehratum', 'Salyan', 'Naval Parasy', 'Palpa', 'Bhaktapur', 'Bhojpur' and 'Illam' (Sasikumar, 2000). Though about 50 ginger cultivars are known in Nepal, some of them may not be genetically distinct as these cultivars are recognized after their place of cultivation, mainly.

Propagation

Ginger is propagated through rhizome saved from previous harvest.

Turmeric

Genus *Curcuma* is gaining global importance as a potential source of new drug(s) to combat a variety of ailments as the genus contains molecules credited with many therapeutical, insect repellent and aromatic properties.

Origin and Producing Countries

Curcuma is mainly of South Asian origin and centre of diversity of *Curcuma* also falls within this region. Turmeric though grown in India, Pakistan, Malaysia, Myanmar, Vietnam, Thailand, Philippines, Japan, China, Korea, Sri Lanka, Nepal, South Pacific Islands, East and West Africa, Malagasi, Carribean Islands and Central America, India is the major producer and exporter of this spice. Turmeric is grown in about 1.5 lakh ha. in India. Andhra Pradesh, Orissa, Tamil Nadu, Meghalaya, West Bengal and Maharashtra are the major turmeric producing states in India.

Species Diversity of *Curcuma* and Systematics

Curcuma species widely differ in their habitat. Habitat ranges from sea level (sandy coastal) to high altitude as above 200 m in Western Ghats and Himalayas. In India, *Curcuma* species diversity is

concentrated in North-Eastern India, South India and Andaman and Nicobar Islands. Other countries rich in *Curcuma* species diversity are China, Thailand, Malaysia, Philippines and Vietnam. Economically important *Curcuma* species are given in Table 11.5.

Table 11.5: Economically Important *Curcuma* spp.

Species	Uses
<i>C. longa</i> L. syn <i>C. domestica</i> Val.	Spice, medicine, dye, religious local delicacies, insect repellent, aroma therapy and perfume.
<i>C. amada</i> Roxb, <i>C. mangga</i> Val. & Zijp.	Spice, medicine, pickles and salads
<i>C. zedoaria</i> Roxb.	Folk medicine, arrow root industry
<i>C. ochrorrhiza</i> Val and Van Zijp	Malayan traditional medicine
<i>C. pierreana</i> Gagnep.	Vietnamese traditional medicine
<i>C. aromatica</i> Salsb.	Medicine, toiletry articles, insect repellent
<i>C. kwangsiensis</i> S. G. Lec and C.F. Liang syn.	
<i>C. chuanyujin</i> , <i>C. phaeocaulis</i> Val.	Chinese traditional medicine
<i>C. caesia</i> Roxb.	Spice and medicine
<i>C. comosa</i> Roxb.	Traditional medicine of Thailand
<i>C. angustifolia</i> Roxb, <i>C. zedoaria</i> Roxb.	
<i>C. caulina</i> F. Grah, <i>C. psuedomontana</i> F. Grah.	
<i>C. montana</i> Roxb, <i>C. rubescens</i> Roxb.	Arrow root industry
<i>C. leucorrhiza</i> , <i>C. xanthorrhiza</i> Roxb	
<i>C. decipiens</i> Dalz. <i>C. malabarica</i> Vel et al.	
<i>C. raktakanta</i> Mangaly and Sabu, <i>C. haritha</i>	
<i>C. aeruginosa</i> Roxb.	
<i>C. alismatifolia</i> Gagnep, <i>C. thorelii</i> , <i>C. roscoeana</i> Wall.	Ornamental (Cut flower)

Source: Sasikumar (2005).

Though about 100 *Curcuma* species are proposed globally, it is now recognized that some of the species may be synonyms such as *C. zedoaria* syn. *C. xanthorrhiza* (India), *C. albicoma* syn. *C. sichuanensis*; *C. chuanyujin* syn. *C. kwangsiensis*, *C. wenyujin* syn. *C. aromatica* (China) etc. (Sasikumar 2005). Velayudhan et al. (1999) recorded a total of 117 species (Table 11.6), obviously including synonymous entities as separate species.

Genus *Curcuma* belonging to Hedycheae contains about 80 species out of which 41 are distributed in India including at least 10 species endemic to India.

Velayudhan et al. (1996) proposed a new conspectus of genus in India. These authors found that Indian species can be accommodated in two subgenera of Valetton (1918) viz. *Eucurcuma* and *Paracurcuma*. *Eucurcuma* contains 3 main sections namely *tuberosa*, *nontuberosa* and *stolonifera* based on presence or absence of tubers and stolons, each section again encompassing one or more subsections based on floral, vegetative and rhizome characters. Under subgenus *Paracurcuma*, only the anther spurs lacking species viz. *C. aurantiaca* and *C. ecalcarata* are included. Velayudhan et al. (1999) also proposed existence of 21 distinct morphotypes in *Curcuma longa*. These 21 morphotypes are grouped into six taxonomic varieties namely *C. longa* var. *typica*, *C. longa* var. *atypical*, *C. longa* var. *camphora*, *C. lona* var. *spiralifolia*, *C. longa* var. *musacifolia* and *C. longa* var. *platifolia*. Most of the Indian morphotypes belong to *C. longa* var. *atypia*.

Table 11.6: Species Diversity of *Curcuma*

Sl.No.	Species	Origin	Sl.No.	Species	Origin
1.	<i>Curcuma aeruginosa</i> Roxb.	Myanmar	38.	<i>C. pseudomontana</i> F. Grah.	
2.	<i>C. albiflora</i> Thaw.	Sri Lanka	39.	<i>C. purpurescens</i> Blume.	Java
3.	<i>C. amada</i> Roxb.	India	40.	<i>C. reclinata</i> Roxb.	India
4.	<i>C. amarissima</i> Rosc.	India	41.	<i>C. roscoeana</i> Wall.	Myanmar
5.	<i>C. americana</i> Lam.		42.	<i>C. rotunda</i> Linn.	
6.	<i>C. angustifolia</i> Dalz and Gibs.	India	43.	<i>C. rubescens</i> Roxb.	India
7.	<i>C. angustifolia</i> Roxb.	India	44.	<i>C. rubricaulis</i> Link	
8.	<i>C. aromatica</i> Salisb.	India	45.	<i>C. strobilifera</i> Will.	Myanmar
9.	<i>C. attenuata</i> Wall.	Myanmar	46.	<i>C. strobilia</i> Wall.	India
10.	<i>C. australasiaca</i> Hook. f.	Australia	47.	<i>C. sumatrana</i> Miq.	Sumatra
11.	<i>C. caesia</i> Roxb.	India	48.	<i>C. viridiflora</i> Roxb.	Sumatra
12.	<i>C. careyana</i> Wall.	India	49.	<i>C. xanthorrhiza</i> D. Dietr.	Malaya
13.	<i>C. caulina</i> F. Grah.	India	50.	<i>C. xanthorrhiza</i> Roxb.	
14.	<i>C. comosa</i> Roxb.	Myanmar	51.	<i>C. zedoaria</i> Rosc.	India
15.	<i>C. cordata</i> Wall.		52.	<i>C. zedoria</i> Roxb.	
16.	<i>C. cordifolia</i> Roxb.		53.	<i>C. zerumpet</i> Roxb.	
17.	<i>C. decipiens</i> Dalz.	India	54.	<i>C. bakertiana</i> Hunsli.	New Guinea
18.	<i>C. alata</i> Roxb.	Myanmar	55.	<i>C. coccinia</i> Wall.	
19.	<i>C. erubescens</i> Wall		56.	<i>C. sylvestris</i> Redl	Malayasia
20.	<i>C. ferrugenia</i> Roxb.	India	57.	<i>C. urceolata</i> Rich.	
21.	<i>C. glaucophylla</i> Wall.		58.	<i>C. ceratotheca</i> Schum.	Celebes
22.	<i>C. grandiflora</i> Wall.		59.	<i>C. sessilis</i> Gag.	Burma
23.	<i>C. latifolia</i> Rosc.	India	60.	<i>C. sparganifolia</i> Gagnep.	Combodia
24.	<i>C. longa</i> Linn.		61.	<i>C. stenochyla</i> Ganep.	Cochin China
25.	<i>C. longiflora</i> Salisb.	India	62.	<i>C. cochinchinensis</i>	Indochina
26.	<i>C. montana</i> Roxb.	India	63.	<i>C. harmnadi</i> Gagnep.	Cochin China
27.	<i>C. musacea</i> Wall.	India	64.	<i>C. lanceolata</i> Ridl.	
28.	<i>C. neilgherrensis</i> Wight	India	65.	<i>C. leopoldii</i> Hot.	
29.	<i>C. officianalis</i> Salisb.		66.	<i>C. pierreana</i> Gagnep.	Indochina
30.	<i>C. oligantha</i> Trim.	Sri Lanka	67.	<i>C. singularis</i> Gagnep	Indochina
31.	<i>C. ornata</i> Wall.	Myanmar	68.	<i>C. thorelii</i>	Indochina
32.	<i>C. pallida</i> Lour.	China	69.	<i>C. trichosantha</i> Gagnep.	Indochina
33.	<i>C. parviflora</i> Wall.	Myanmar	70.	<i>C. heyneana</i> Val. and Zijp.	Java
34.	<i>C. petiolaris</i> Hort.		71.	<i>C. loerzingii</i> Val.	Sumatra
35.	<i>C. petiolata</i> Roxb.	Myanmar	72.	<i>C. longi-spica</i> , Val.	N. Guinea
36.	<i>C. spicata</i> Wall.	Myanmar	73.	<i>C. mangga</i> Val. and Zijp.	Java
37.	<i>C. porphyrotannica</i> Zijp.	Timor	74.	<i>C. ochrorhiza</i> , Val. and Van Zijp.	Java
			75.	<i>C. phaeocaulis</i>	Java

Table 12.6—Contd...

Sl.No.	Species	Origin	Sl.No.	Species	Origin
76.	<i>C. soloensis</i> Val.	Java	96.	<i>C. kunstleri</i>	
77.	<i>C. sylvatica</i> Val.		97.	<i>C. domestica</i> Val.	
78.	<i>C. aurantiaca</i> Van Zijp	Java	98.	<i>C. speciosa</i> Link	
79.	<i>C. elomata</i> Craib.	Siam	99.	<i>C. viridiflora</i> Roxb.	Java
80.	<i>C. latiflora</i> Val.	New Guinea	100.	<i>C. colorata</i> Val.	Java
81.	<i>C. sulcata</i> Haines	India	101.	<i>C. euchroma</i> Val.	Java
82.	<i>C. elata</i> Roxb.	Myanmar	102.	<i>C. ochrorrhiza</i> Val.	Java
83.	<i>C. inodora</i> Blatter	India	103.	<i>C. brog</i> Val.	Java
84.	<i>C. petiolata</i> Roxb.	Myanmar	104.	<i>C. agrostis</i> Sare	
85.	<i>C. purpurea</i> Blatter	India	105.	<i>C. ranadei</i> Prain	
86.	<i>C. zanthorrhiza</i> Roxb.	Amboinea	106.	<i>C. haritha</i> Mangaly and Sabu	India
87.	<i>C. zedoaria</i> (Bergius) Roscoe		107.	<i>C. raktakanta</i> Mangaly and Sabu	India
88.	<i>C. burtii</i> K. Lasru and R.M Smith	Thailand	108.	<i>C. kudagensis</i> Vel. et.al	India
89.	<i>C. kwangsiensis</i> S.G. Lee and C.F. Liang	China	109.	<i>C. thalakaveriensis</i> Vel. et.al	India
90.	<i>C. curcumorpha</i> Rao and Verma	India	110.	<i>C. malabarica</i> Vel et.al	India
91.	<i>C. longiflora</i> (Wall.). Rao and Verma	India	111.	<i>C. karnatakensis</i> Amal. et.al	India
92.	<i>C. ecalcarata</i> Sivar and Indu	India	111.	<i>C. niodona</i>	
93.	<i>C. sichuanensis</i> Gagnep.	China	113.	<i>C. nilambuensis</i> Amal et.al	India
94.	<i>C. alismatifolia</i> Gagnep.	Thailand	114.	<i>C. kannanorensis</i> Ansari and Nair	India
95.	<i>C. gracilima</i> Gagnep.		115.	<i>C. vamana</i> Mangaly and Sabu	India
			116.	<i>C. lutea</i> Ansari and Nair	India
			117.	<i>C. peethapushpa</i> Sandh and Sivar	India

Source: Velayudhan et al., 1999.

Taxonomic classification and systematics of genus may not be fool proof as there are many problems like lack of type specimens and illustration of old species, and absence of important floral parts in herbariums, fleshy and perishable aerial portions etc. and recent molecular taxonomic studies of 16 *Curcuma* species also pin point this fact (Shyamkumar and Sasikumar, 2005).

Cultivar Diversity

Cultivar diversity of cultivated turmeric is the highest in India. In India South India, Orissa and North Eastern states are rich in cultivar diversity. A good number of varieties also exist in other producing countries like Bangladesh, Pakistan, Vietnam, Nepal, Myanmar, South Pacific Islands, Malagasi etc. Cultivar diversity of turmeric in India is given in Table 11.7.

Turmeric cultivars of India are classified as short duration varieties (G.L Puram, Kasturi, Jabedi, Dughi, Dindigram, Udayagiri Amalapuram); medium duration varieties (Kesari, Kothapeta, Amruthapani, Rajapuri, Panamalur, Gorakpur) or long duration varieties (Armoor, Duggirala, Mydukur Tekurpet, Sugandham, Avanigadda, Ethamkula). Short duration varieties are characterized by thick, long rhizome, low curcumin and early maturity (180-200 days). These varieties yield about 8-

20 tonnes (fresh) rhizome/ha. Medium duration varieties mature in about 230-240 days, and possess medium long, with close internodes, thick rhizome. These varieties yield about 14-35 tonnes (fresh)/ha. Long duration varieties are characterized by long, stout, smooth and hard rhizomes. These cultivars take about 9 months for maturity and yield about 15-37 tonnes/ha. (fresh rhizome).

Table 11.7: Cultivar/Varietal Diversity in Turmeric

Sl.No.	Cultivar/variety	Sl.No.	Cultivar/Variety
1	Armur ✓	35	Lokhande
2	Alleppey ✓	36	Lekadong ✓
3	Alleppey Supreme*	37	Mundage
4	Avanigadda	38	Megha turmeric*
5	Amruthapani ✓	39	Mydukkur ✓
6	Amalapuram ✓	40	Nandyal
7	Balaga	41	Pattani
8	Bilaspur	42	Panamalur
9	BSR-1*	43	Pakistan
10	BSR-2*	44	Perumnadan
11	Bullapura	45	Prabha*
12	C-A-72 Udayagiri	46	Prathibha*
13	C-A-12	47	Rajapuri ✓
14	CLL- 324	48	Ranga*
15	CLL- 328	49	Rasmi
16	Chinnanadan	50	Rajendra Sonia*
17	Chaya paspu	51	Roma*
18	Co-1*	52	Sobha*,
19	Deshi	53	Sona*
20	Duggirala ✓	54	Shimla
21	Dunrigam	55	Sugantham*
22	Dughi	56	Suguna*
23	Erode Local ✓	57	Suvarna*
24	Ethamukkala	58	Sudarsana*
25	Gorakpur	59	Suranjana*
26	Guntur	60	Suroma*
27	GL Puram	61	Thekkurpetta ✓
28	Jabedi (G-67)	62	TSundar
29	Kanti*	63	Thalachira
30	Kasturi Tanaka	64	Varna*
31	Kasturi	65	Vonimitta
32	Katpadi Local	66	Waynadan ✓
33	Kedaram*	67	Yelachage
34	Kothapetta ✓		

*: Improved variety.

Turmeric varieties/cultivars such as Alleppey, Lekadong Prabha, Prathibha, Kedaram, Alleppey Supreme, Wyand Local, Mananthody, Aieng, Edappalayam, Roma and Sugandham are rich in curcumin (above 5 per cent) Turmeric varieties also differ in their curcuminoid levels too. Variety x location interaction is very high for curcumin content.

Propagation

Turmeric is propagated, like ginger, vegetatively by means of rhizomes saved from previous harvest. Unlike in ginger, viable sexual reproduction and true turmeric seedling production are there in this spice (Sasikumar *et al.*, 1996) though cultivated *C. longa* is triploid ($2n=63$). Major contribution of cultivar diversity in turmeric too must be due to geographical spread of varieties accompanied by genetic differentiation into locally adapted populations, caused by mutation plus selection.

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Foreword

Horticultural crops—fruits, vegetables, ornamental plants, tuber crops, plantation crops, spices, medicinal and aromatic plants and mushrooms—constitute the foundation of nutritional and livelihood security of India. They occupy 9 per cent of gross area under cropping, contributing 24.5 per cent of gross value of agricultural output and 54.6 per cent of export earnings in agriculture. India ranks first in production of mango, banana, cauliflower, coconut, cashew, tea and spices. If India has to achieve 8 per cent rate of growth in GDP, growth rate in horticulture has to be 6 per cent. National Horticultural Mission launched by Government of India envisages higher productivity, clean and environment friendly production, value addition and above all sustainability of natural resources especially biodiversity and water. Horticultural genetic resources include improved and obsolete varieties, populations, landraces, genetic stocks and breeding materials of crop plants and their wild and weedy relatives. Many fruit crops like mango, citrus and banana have their centres of diversity in tropical India/South East Asia. Minor fruits like *bael*, Indian gooseberry, papaya, jackfruit, custard apple, *karonda*, cordia, *phalsa*, *kokam*, mangosteen, *ber*, strawberry, blackberry and raspberry, currant and kiwi fruit have potential for cultivation. Vegetable crops having rich diversity in India are cucurbits, leaf vegetables, brinjal, okra and chilli. Tubers like yams, aroids and yam beans have importance in starch and bioethanol industry. In India, significant diversity occurs in medicinal and aromatic plants. *Aswagandha*, *rauvolfia*, *safed musli*, *babchi*, belladonna, atees, Indian barberry, Indian gentian, *kutki* and Indian henbane are a few such crops. Important ornamentals native to India are orchids, rhododendrons, muskrose, lotus and begonias. Ornamental trees are bauhinia, cassia, flame of forest, Indian coral tree, pride of India and tulip trees.

The collection, characterisation, evaluation, conservation and utilization of Horticulture Genetic Resources (HGR) are important for India which has a vast heritage of these bioresources. The present national network is co-ordinated by National Bureau of Plant Genetic Resources (NBPGR), New Delhi and its Regional Stations. There are 13 All India Co-ordinated Research Projects under the

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